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A STUDY OF THE BIOLOGY OF *RHOPALOSIPHUM PADI* (HOMOPTERA: APHIDIDAE) IN WINTER WHEAT IN NORTHWESTERN INDIANA

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A STUDY OF THE BIOLOGY OF *RHOPALOSIPHUM PADI* (HOMOPTERA: APHIDIDAE) IN WINTER WHEAT IN NORTHWESTERN INDIANA[1]

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ABSTRACT

Periodic collections of the bird cherry-oat aphid, *Rhopalosiphum padi*, during two years revealed small populations on winter wheat in Lafayette, Indiana. The greatest numbers were found on volunteer wheat plants before planting. In the autumn, aphids were detected on one-shoot plants by mid-October and also early March. The populations remained small until mid-June. We conclude that the aphid feeding did not significantly affect the plants, but helped spread barley yellow dwarf virus.

The bird cherry-oat aphid, *Rhopalosiphum padi* (L)., is an important insect pest of cereals, damaging the hosts both by feeding and by transmitting barley yellow dwarf virus (BYDV) (Stern 1967, Kolbe 1973). In the United States, severe epidemics of BYDV in small grains apparently occurred prior to 1951 (Anon. 1959, Bruehl 1961, Rochow 1961). The aphid has a wide range of hosts that include various species of cereals and grasses as summer hosts, and *Prunus* spp. as fall and spring hosts (Richards 1960, Robinson and Hsu 1963).

Several reports documented losses in small grains due to feeding damage, BYDV, and their combined action. For example, in Indiana yield losses were estimated at about 27.5% in oats due to infection by BYDV in 1959 (Caldwell et al. 1959), while in Mississippi, reported losses in oat yields were as high as 30–40% (Rothman et al. 1959). In Canada, seed weight losses of 60–86% occurred for spring wheats naturally infected with BYDV in 1978 (Gill 1980). Fall infections of BYDV on hard red winter wheat in Kansas caused yield reductions of 25–60%, while spring infection yield reductions were 5–35% (Palmer and Sill 1966). Similar results were obtained by Carrigan et al. (1981).

In Italy, spring barley, immediately after sprouting became infested by aphids that had previously developed on maize (Suss and Colombo 1982). In the autumn, aphids (especially *R. padi* and *Sitobion avenae* (Fabricius)) infested the basal leaf-sheaths of maize, from which they migrated to the tender shoots of well-fertilized wheat and barley when the maize plants dried up. A relationship was established between spring cereals and *R. padi* and *Metopolophium dirhodum* (Walker), which were able to transmit BYDV from maize (on which it produced no symptoms) or wild grasses and pass it on to wheat and barley.

The interaction of *R. padi* with cereals warrants the study of its biology and makes the study of its relationships with BYDV a necessity. The objectives of this research were to

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study the life cycle of *R. padi* on winter wheat in the field, in order to evaluate the feasibility of controlling alate migrant aphids (BYDV vectors) in early fall, and late spring crops.

MATERIALS AND METHODS

The number of *R. padi* on wheat was determined from weekly samples of 50 stems. These were taken randomly from four blocks with three wheat plots each, corresponding to three different wheat rotations with corn and soybeans from the USDA-ARS Integrated Pest Management Project at the Purdue University Agronomy Farm located near Lafayette, Indiana. Samples were taken throughout the year when the crop was present for two years, starting in September 1982 with volunteer wheat plants. Winter wheat seedlings were sampled during the fall of 1982, and in the same fields during spring 1983. The second season commenced October 1983 and continued through June 1984 except in midwinter.

Since many *R. padi* develop within the seedling leaf whorls, the sample plants were cut at ground level and placed in vials in 70% alcohol. The aphids per seedling or per stem in taller plants, were counted later in the laboratory. This method has proven to be effective in determining the proportions of different morphs of *S. avenae* in field studies in England by Dewar et al. (1982).

RESULTS AND DISCUSSION

The numbers of *R. padi* collected periodically on winter wheat plots during two crop cycles (1982–83 and 1983–84) appear in Figure 1. The data are expressed as the average number of nymphs, apterae, and alatae collected on 50 stems.

The wheat plots where the aphids were collected were part of a study with three different rotations including wheat, corn, and soybeans, the most common crops in Indiana. The aphids collected are representing the average number occurring in winter wheat rotated with other crops.

Aphid numbers were low during both crop years. The highest populations occurred in 1982 on volunteer wheat plants just prior to fall planting (Fig. 1). These and other graminaceous plants were important sources of aphid infestation and BYDV inoculum for wheat seedlings in October. The small seedlings are often invaded by alate aphids that are efficient vectors of the virus (Gill 1970, 1972). Even though present in small numbers, they spread the virus in the crop when it is most susceptible (Endo and Brown 1963, Smith 1967). It has been reported that a fall infection of winter wheat by BYDV is more severe than a spring infection (Palmer and Sill 1966). During a mild winter, some aphids may survive, and although normally inactive during the cold months (Forbes 1962, Harper and Blakeley 1968), they become active and start reproducing parthenogenetically earlier in spring (Dixon 1971), causing larger infestations than average.

In 1983, the first aphid nymphs were collected on 5 March, when the plants were in the one-leaf stage (stage 1 of the Feekes scale [Large 1954]) and probably were progeny of winged immigrants that had arrived earlier. The first winged individuals were collected on 20 May. The populations were relatively small until mid-June, when aphids were easily detected by sight; however, by this time the crop had flowered (stage 10.5.4 of Feekes) and most of the aphids were below the heads. It is thought that plants can withstand such infestations without any adverse effect on the yield. As the crop matured and the temperatures of summer increased, the populations declined to nearly negligible levels. The heat and drought of the summer of 1983 are believed to have been the cause of the small population available to attack wheat the following fall. The aphids were detected on 14 October 1983, on plants at the one-leaf stage, and winged immigrants were collected on 26 October. The population remained small until 8 June and reached a peak on 15 June. This increase occurred after all the heads had formed and were out of the sheath

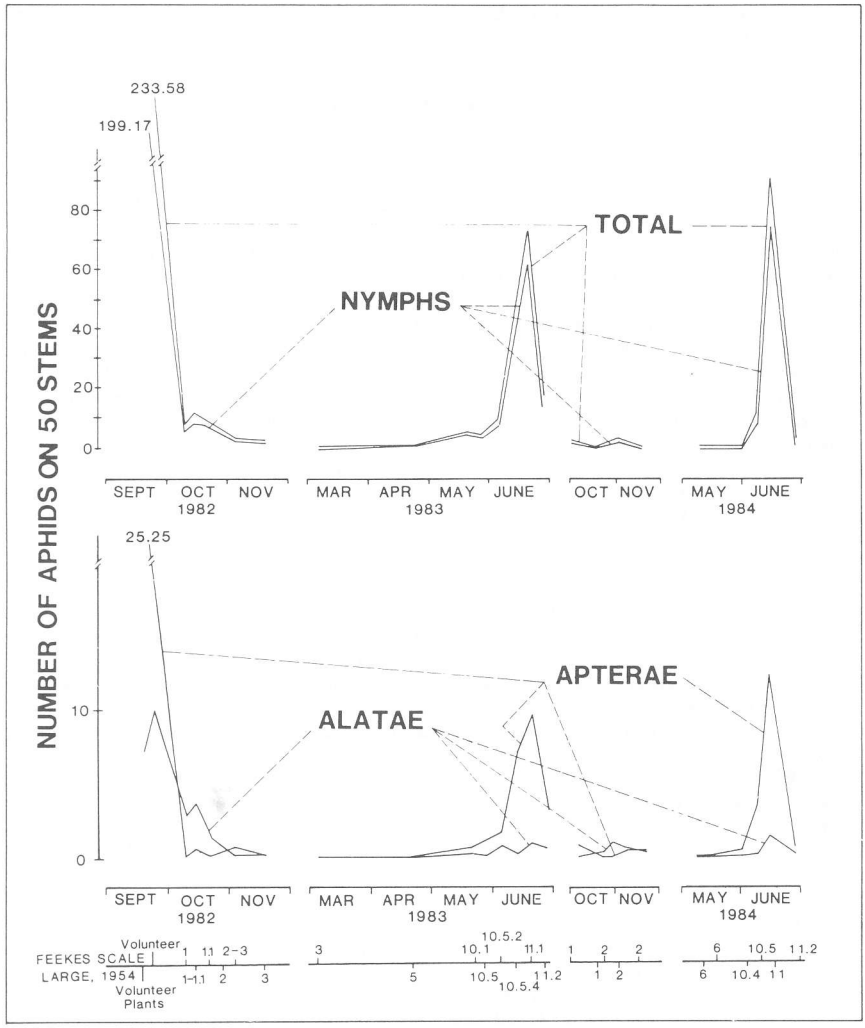

Figure 1. Numbers of ***Rhopalosiphum padi*** collected on wheat plots in the Integrated Pest management Area at the Purdue Agronomy Farm

(stage 10.5 of Feekes); the maximum number occurred during the ripening (stage 11), and was of a relatively low level. We conclude that in 1984 the crop was unaffected by direct aphid feeding.

From this study, aphids invaded winter wheat crops in the area of Lafayette, Indiana, early in the season, enabling winged immigrants to spread BYDV when the crop was most susceptible to the virus. Relatively large numbers of winged aphids such as found on volunteer wheat in September of 1982, pose a danger to wheat crops in Indiana that may

become infected very early with BYDV. This danger may increase as minimum tillage practices gain widespread acceptance, leading to more volunteer wheat.

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